Neural Networks And Its Learning Techniques

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Abstract: A neural network is an artificial representation of the human brain that tries to simulate its learning process. An artificial neural network (ANN) is often called a "Neural Network " or simply Neural Net (NN). This paper summarizes the some of the most important developments in neural network and its learning techniques. Learning can be done in supervised or unsupervised training. Our purpose is to provide a synthesis of the published research in this area and stimulate further research interests and efforts in the identified topics.

Index Terms— Learning and learning process, costs, neural networks, Error_correction learning, Memory based learning, mathematical ananlysis, Artificial intelligence.

Introduction

Research in the field of neural networks has been attracting increasing attention in recent years. Since 1943, when Warren McCulloch and Walter Pitts presented the first model of artificial neurons, new and more sophisticated proposals have been made from decade to decade. Mathematical analysis has solved some of the mysteries posed by the new models but has left many questions open for future investigations. Needless to say, the study of neurons, their interconnections and their role as the brain's elementary building blocks is one of the most dynamic and important research fields in modern computer science. It is not an exaggeration to say that we have learned more about the nervous system in the last fifty years than ever before. Artificial neural networks are an attempt at modeling the information processing capabilities of nervous system.

Neural networks are a branch of "Artificial Intelligence". Artificial Neural Network is a system loosely modeled based on the human brain. The field goes by many names, such as connectionism, parallel distributed processing, neuro computing, natural intelligent systems, machine learning algorithms, and artificial neural networks. Neural networks are a powerful technique to solve many real world problems. They have the ability to learn from experience in order to improve their performance and to adapt themselves to changes in the environment. In addition to that they are able to deal with incomplete information or noisy data and can be very effective especially in situations where it is not possible to define the rules or steps that lead to the solution of a problem.

Learning Process

One of the most important aspects of Neural Network is the learning process. The learning process of a Neural Network can be viewed as reshaping a sheet of metal, which represents the output (range) of the function being mapped. The training set (domain) acts as energy required to bend the sheet of metal such that it passes through predefined points. However, the metal, by its nature, will resist such reshaping. So the network will attempt to find a low energy configuration (i.e. a flat/non-wrinkled shape) that satisfies the constraints (training data).

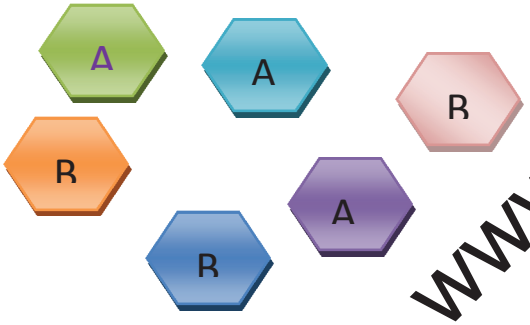
Learning is a process by which the free parameters of a neural network are adapted through a process of stimulation by the environment in which the network is embedded. The type of learning is determined by the manner in which the parameter changes take place.

This definition of the learning process implies the following sequence of events:

1. The neural network is stimulated by an environment.
2. The neural network undergoes changes in its free parameters as a result of this stimulation
3. The neural network responds in a new way to the environment because of the changes that have occurred in its internal structure.

Learning can be done in supervised or unsupervised training. In supervised training, both the inputs and the outputs are provided. The network then processes the inputs and compares its resulting outputs against the desired outputs. Errors are then calculated, causing the system to adjust the weights which control the network. This process occurs over and over as the weights are continually tweaked.

Supervised and un-supervised:



Two possible solutions:

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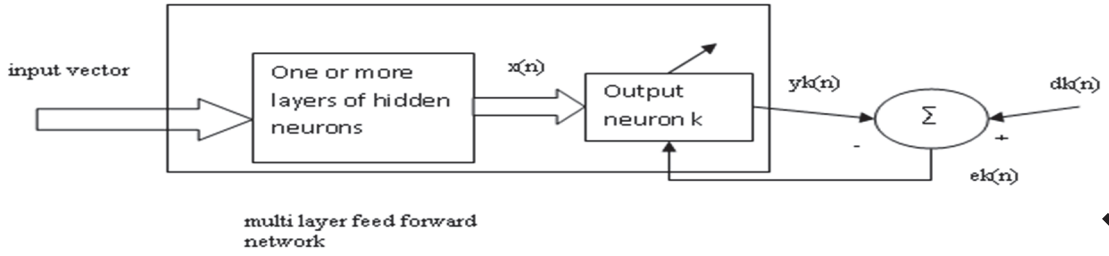
In this paper we are going to learn different learning techniques those are 1. Error_ correction learning 2. Memory based learning

1. Error_correction learning: To understand this technique, assume a simple case of a neuron k constituting the only computational node in the output layer of a feed forward neural network, as depicted in fig1



Neuron k is driven by a signal vector x(n) produced by one or more layers of hidden neurons, which are themselves driven by an input vector applied to the source nodes of the neural network.

Consequently, an error signal, denoted by $e_k(n)$, is produced. By definition,

$$e_k(n) = d_k(n) - y_k(n)$$

this objective is achieved by minimizing a cost function or index of performance, £(n), defined in terms of the error signal $e_k(n)$ as

$$£(n) = \tfrac{1}{2}\, e^2_k(n)$$

Let $\mathbf{w}_{kj}(n)$ denote the value of synaptic weight $\mathbf{w}_{kj}$ of neuron k excited by element $x_j(n)$ of the signal vector x(n) at time step n. in effect , $\mathbf{w}_{kj}$ (n) and $\mathbf{w}_{kj}$ (n+1) may be viewed as the old new values of synaptic weight $\mathbf{w}_{kj}$, respectively. In computational terms we may also write

$$\mathbf{w}_{kj}(n) = z^{-1}[\mathbf{w}_{kj}(n+1)]$$

where z^{-1} is the unit delay operator. That is z^{-1} represents a storage element.

2. Memory-based learning: here all the past experiences are explicitly stored in a large memory of correctly classified input- output

All memory-based learning algorithms involve two essential ingredients:

- Criterion used for defining the local neighborhood of the test vector X_{test}.
- Learning rule applied to the training examples in the local neighborhood of X_{test}.

The algorithms are differ from differ from each other in the way in which these two ingredients are defined.

Immediate neighborhood of the test vector X_{test}. In particular, the vector

$$X'_N \in \{ X_1, X_2, \ldots, X_N\}$$

Is said to be the nearest neighbor of X_{test} if

$$\min\ d(X_i, X_{test}) = d(X'_N, X_{test})$$

where $d(X'_N, X_{test})$ is the Euclidean distance between the vectors X_i and X_{test}. The class associated with the minimum distance that is vector X'_N is reported as the classification of X_{test}. this rule is independent of the underlying distribution responsible for generating the training examples.

A variant of the nearest neighbor classifier is the k-nearest neighbor classifier which proceeds as follows:

- Identify the k classified patterns that lie nearest to the test vector X_{test} for some integer k.
- Assign to the class that is most regularly represented in the k nearest neighbors to X_{test}.

Thus the k-nearest neighbor classifier acts like an averaging device.

Conclusion

In this paper, we have studied one of the most important limitations of neural networks, that is understanding why an neural networks, that is understanding why an neural networks makes a particular decision is a very difficult task. Also we have learn about learning processes and how it works. How the data is divided into supervised and un-supervised. And what are the different learning techniques and how those works under various neural networks.

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